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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

PRINT VERSUS DIGITAL: EFFICACY OF MEDIUM ON COMPREHENSION AND WITHIN LEARNING SETTINGS

by

Mitchell J. McCarthy, Colonel, USMC (Ret)

September 2021

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In this digital age, the debate between the instructional efficacy of reading medium, digital versus print, continues. Regardless of the debate points, the print medium continues to reign as the superior of the two in terms of comprehension level, preferability, and general ease of use. Perhaps, this is due to its' physical nature, or because it had been the single medium for reading until this current era, where readers have a choice and exercise it regularly. Certainly, digital manifests a host of benefits, such as modality, portability, and it comes in as less costly per page than print. Nevertheless, it comes down to the intent of the instruction. The instructional designer should carefully consider that intent before choosing a medium to use. The report finds print better for longer building block, conceptual reasoning, or linear reading purposes, while digital can be useful for goal-oriented reading, for studying, or research purposes. As such, this report recommends that the medium chosen depends on the overall intent of the instruction.

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ABSTRACT

In this digital age, the debate between the instructional efficacy of reading medium, digital versus print, continues. Regardless of the debate points, the print medium continues to reign as the superior of the two in terms of comprehension level, preferability, and general ease of use. Perhaps, this is due to its' physical nature, or because it had been the single medium for reading until this current era, where readers have a choice and exercise it regularly. Certainly, digital manifests a host of benefits, such as modality, portability, and it comes in as less costly per page than print. Nevertheless, it comes down to the intent of the instruction. The instructional designer should carefully consider that intent before choosing a medium to use. The report finds print better for longer building block, conceptual reasoning, or linear reading purposes, while digital can be useful for goal-oriented reading, for studying, or research purposes. As such, this report recommends that the medium chosen depends on the overall intent of the instruction.

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I. INTRODUCTION

In our highly connected world, human interaction with the internet of things creates an estimated 2.5 quintillion bytes of data per day.[1] This created data spans from scholarly articles, books, or novels in written format to data collected on purchasing transactions, to inventory control systems, to banking transactions, to e-mails, to tweets, the list is endless. Accompanying this proliferation of digitized information, many ask how well do individuals, primarily reading through this veritable mountain of information, comprehend what they are ingesting digitally. This report compares the digital and print mediums and their impact on individuals' reading comprehension.

More discretely, the subject of this research revolves around the educational or instructional difference between digital and print format on a reader's comprehension via skimming, or discontinuous reading, deep reading, or immersion into the material read.[2]

---

[1] In 2017, it was estimated that daily humans create 2.5 quintillion bytes of data, the equivalent to approximately of 47 million Blu-Ray ©, high capacity, storage discs (IBM, 2018). Each Blu-Ray© disc holds 50 gigabytes of data. If one placed each of the 47 million discs atop the other starting at sea level, the stack of discs would tower to the height 56 kilometers or approximately 35 miles–just beyond the Earth's stratosphere (Layers of Earth's Atmosphere, 2018). That figure is calculated by equating 2.5 quintillion bytes to 2.33 billion gigabytes. One Blu-Ray© disc holds 50 gigabytes. By dividing the 2.33 billion gigabytes by 50 equals 46.6 million discs. A single Blu-Ray© disc has a width of 1.2 millimeters or 0.00394 of a foot. By multiplying 46.6 million by the width of the disk, one derives the height in feet spanned by stacking each disk atop or 183,604 feet, which equates to 56 kilometers or 35 miles once converted. It is estimated that only about 0.5% of this data is used or analyzed by humankind per day (Regalado, 2013).

[2] Comprehension – retrieving previously acquired schema to assist in processing and understanding new and unfamiliar information while reading or listening to text (Ortlieb, Sargent, & Moreland, 2014; Ziegler, 2019, p. 10). See schema theory in the glossary.

Discontinuous reading – a. reading non-linearly, back and forth, jumping around in the text, reading out of order, or reading snippets to gain specific knowledge (i.e., question and answer schema), context, or to decide whether to read further; employing an immersive reflective heuristic to understand connections, to interpret and learn the specifically sought elements of the material read, largely done in research or study settings (Cull, 2011; Hillesund, 2010, p. 5; Liu, 2005, p. 700). b. reading as an information seeking or interrogatory endeavor about a specific subject, using organizational constructs within the given text such as annotations, bibliographies, glossaries, hyperlinks, indices, or tables of content to obtain the information sought, indicative of a shallower level of cognitive processing (Cull, 2011; Hillesund, 2010; Liu, 2005, p. 700; Rowe, 2013, pp. 6-7; Sage, Piazzini, Downey, & Masilela, 2020). Discontinuous reading is *synonymous* in this report with *reviewing*, *scanning*, *skimming*, or *tabular* reading, where the reader rapidly scans the given text for keywords, phrases, and images to assuage their information-seeking need or to swiftly learn the required knowledge.

First, the report explores which medium allows the reader to create a rich, cognitive map through a deep reading of a narrative allowing the reader to generate analogically immersive imagines of the given storyline.[3] Next, it surveys which medium best enables discontinuous reading, with its' immersive reflective properties, through enhanced use of reviewing, skimming, or scanning of information with discrete knowledge acquisition goals in mind.

As such, this report utilizes the extant literature as the basis with which to explore the differences between the two mediums and their effect on the reading-learning process. Specifically, the research examines each medium's reading efficacy in blended, distance (i.e., online), and traditional learning settings.[4] As such, the report's research question is as follows.

Deep reading - the array of sophisticated processes that propel comprehension and that include inferential and deductive reasoning, analogical skills and imagery of the narrative, largely linear in execution – reading from start to finish, gaining knowledge through the use of an immersive imaginary heuristic (Cull, 2011; Durant & Horava, 2015, p. 9; Hillesund, 2010; Liu, 2005; Rowe, 2013; Wolf & Barzillai, 2009, pp. 32-33). Deep reading is *synonymous* in this report with *continuous*, *immersive imaginary*, or *linear reading*, defined by its fundamental integrity of form and content and its innate ability to support sustained engagement between the reader and the text (Durant & Horava, 2015; Hillesund, 2010; Rowe, 2013; Wolf & Barzillai, 2009).

Immersion – refers to the sense of engagement or an experience of losing oneself in an environment; a complete focus on the environment and an appealing engrossment free of distraction or interruption (Hou, Nam, Peng, & Lee, 2012; Hou, Rashid, & Lee, 2017, p. 88; Mangen, 2008, pp. 406-407; Witmer & Singer, 1994).

[3] Cognitive map – refers to the internal model of the world, created by the reader, that accounts for the relationships between events and predicts the consequences of actions (Behrens, et al., 2018, p. 490; Bielenia-Grajewska, 2013; Hou, Rashid, & Lee, 2017).

[4] Distance learning (DL) – education or training delivered at a distance from the hub of instruction, through the use of information technology enabled instructor and learner tools or interfaces (Bertelsen, 2020, p. 7). DL can be asynchronous or synchronous.

Traditional learning – education or training furnished in an in-person, face-to-face, format, is instructor and learner centric, and commonly includes a combination of lectures, case studies, problems, readings, and facilitated peer discussions in a traditional classroom setting (Bertelsen, 2020, p. 7).

Blended learning – education or training that occurs via a mixed-methods (i.e., DL and traditional learning) presentations, whereby participants engage in the activity through varying combinations of distance and traditional learning (Bertelsen, 2020, p. 7).

Motivation for Inquiry: When considering the reading mediums, digital or print, which are the most *effective* either across or within the blended, distance, or traditional learning settings?

Figure 1. Research Question

Further, the report conducts an exploration of the relationship between the reader and the instructional designer. Specifically, how the intended reader will make metacognitive regulatory (MLR) decisions to economically spend their precious time in the acquisition of required knowledge.[5] As such, prior to the reader's MLR decision, the instructional designer must have *actively* considered, which medium type meets the comprehension level targeted to achieve their knowledge transfer goals. The designer's deliberate act will align the instruction's goals with the reader/student's knowledge acquisition goals. Assistance in this endeavor remains a goal of this research.

Finally, this research rests firmly within Narrative and Schema Theory.[6] Loosely, the function of reading enables and requires the reader to comprehend the information presented and cognitively place it in some ordered manner or schema for use (Bielenia-Grajewska, 2013; Singer & Alexander, 2017; Ziegler, 2019). This use spans from recall for a future presentation to application in life's journey. Next, the author defines the report's structure.

First, the discussion begins with a literature review, which incorporates the discrete findings necessary to posit several hypotheses on the differences between the two mediums. Secondly, the analysis and conclusion section, discretely explores each

[5] Metacognitive [learning] regulation (MLR) - refers to higher-order thinking which involves active control over the cognitive processes engaged in learning toward achieving one's goals (Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012, p. 2).

[6] Narrative Theory – a. the institutionalized use of semiotic structures or codes to allow narrators (i.e., authors), and readers to communicate through texts; thereby, allowing the reader to understand and make sense of a given situation described in the story (Barbatsis, 2004; Kearns, 2005). b. information that actively engages the senses using language to create structure that intentionally draws in the reader or listener leaving out pieces of information, or the other side of the story, in an effort to engage the reader or listener by inviting them to use their imagination to fill in the missing information and discern what really happened (Wake, 2009, p. 674).

Schema theory - a set of ideas related to the cognitive structures that help individuals order, present, evaluate, and apply human knowledge and skills by dividing available information into meaningful units (Bielenia-Grajewska, 2013, p. 675). Also, schema theory can be referred to as schemata.

medium for its efficacy in deep reading, discontinuous reading, comprehension, and immersive properties using a mixed-methods, meta-analysis approach. Thirdly, the same section compares and contrasts, the two mediums to test the hypotheses proffered at the end of the literature review. The author tests the hypotheses by surveying 36 scholarly articles (categorized by type in Appendix A), spanning from qualitative or quantitative experiments, meta-analysis of experiments, and qualitative articles. Finally, the report concludes with a survey of the findings unearthed in the extant literature. Specifically, the report evaluates which medium is best for a range of learning settings and situations. Ultimately, the report ends with a range of recommendations to the Naval Postgraduate School, the Defense Resources Management Institute, and academia denoting, which mediums achieve the optimal results based on the reader's learning setting and situation. The report will proceed in the progression described here.

I. Introduction
II. Literature Review
III. Analysis and Conclusion

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II. LITERATURE REVIEW

A. RESEARCH SETTING

As implied in the introduction, the world of reading and learning has changed drastically over the past thirty years. The advent of the internet, enabled by impressive innovations in information technology (IT), has brought about a change in access to learning, reading, and researching.[7] This transformative revolution has sparked an intense debate within academia revolving around, which medium, digital or print, is best. In the extant literature, all of the scholars went to great lengths to emphasize the benefits and categorically tout the advantages of the digital medium. The accounting of digital's benefits includes convenience, modality, and portability. Nevertheless, undergirding these benefits is the inexorable proliferation of digital devices from Ipads, to Surfaces, to Kindles and Nooks, not to mention the ubiquitous spread of learning and reading applications. Amongst scholars, these changes may create concerns that academia might be falling behind, concerns about what these technological changes mean to academia going forward, or the cost-effectiveness of digital compared to print (Bando, Gallego, Gertler, & Romero, 2016; Clinton, 2019; Hancock, Schmidt-Daly, Fanfarelli, Wolfe, & Szalma, 2016; Ji, Michaels, & Waterman, 2014; Johnston & Salaz, 2019; Liu, 2005; Mizrachi, Salaz, Kurbanoglu, & Boustany, 2018).

Nevertheless, the review begins by delving into the reading mediums ease of use and connection to the blended, distance, and traditional learning settings. Secondly, the research defines a typology and use it to discuss levels of reading comprehension (i.e., efficacy) from scanning or discontinuous reading to deep reading or immersion. Thirdly,

[7] Internet – the single, interconnected, worldwide system of commercial, governmental, educational, and other computer or digital information systems or networks that share (a) the protocol suite specified by the Internet Architecture Board (IAB) and (b) the name and address spaces managed by the Internet Corporation for Assigned Names and Numbers (ICANN) (Committee on National Security Systems, 2015, p. 70; Valeriano & Maness, 2015, pp. 9-17). Used throughout this paper as synonymous with the World Wide Web (WWW), cyberspace, or cyber domain.

Information Technology (IT) Systems – Includes all categories of ubiquitous technology used for the gathering, storing, transmitting, retrieving, or processing of information (e.g., microelectronics, printed circuit boards, computing systems, software, signal processors, mobile telephony, satellite communications, and networks). Synonymous with Information and Communications Technology (Committee on National Security Systems, 2015, p. 62).

the survey delves into print medium's appropriateness and efficacy for use across or within the learning settings. Subsequently, the report reviews the digital medium in the same manner. Finally, based on the 36 articles surveyed in this review, this report proffers several hypotheses regarding the efficacy of each medium contingent upon the level of reading comprehension desired and the level cognitive load each medium places on the reader, which can lead to fatigue or distraction.[8] The report tests the hypotheses by using the conclusions and findings of the scholarly articles surveyed, which span across multiple research methods (i.e., qualitative or quantitative experiments / surveys, meta-analysis of numerous articles on the subject, and qualitative articles).

B. LEARNING SETTINGS

Commonly, most associate print medium with a traditional learning setting. Whereas most align the digital medium with the distance learning (DL) end of the learning spectrum (Stoop, Kreutzer, & Kircz, 2013). However, this does not mean the distance learner cannot elect to print out the material – if they so choose. And, in a blended learning environment, mediums may be blended for optimal impact as well. What remains unknown is which medium aligns best with a given learning setting or whether the instructional designer should simply allow the setting to dictate the medium. While the latter is the easiest, it is not the correct option.

Yet, a more fundamental question continues to linger, begging to be asked and answered. What comprehension level should the instructional designer of the curriculum aim to achieve, declarative or educational – procedural or training?[9] Is the instruction

[8] Cognitive Load – focuses on the interplay between working memory (i.e., short-term), with its limited capacity and duration versus long-term memory (Sweller, 2015). In the context of this paper, a reader must manage their cognitive resources to gain the knowledge they seek. Excessive cognitive load can lead to fatigue, increased likelihood of distraction, reduced satisfaction, and lowered confidence in reading performance (Ben-Yehudah & Eshet-Alkalai, 2018; Chen, Cheng, Chang, Zheng, & Huang, 2014; Hou, Rashid, & Lee, 2017; Johnston & Salaz, 2019; Kaufman & Flanagan, 2016; Liu & Huang, 2008; Mangen, Walgermo, & Brønnick, 2013; Sage, Piazzini, Downey, & Masilela, 2020).

[9] Declarative knowledge – a set of facts, concepts, principles, and theories taught and their relationship among knowledge elements retained for their use in differing future situations (Bertelsen, 2020, p. 11; Kraiger, Ford, & Salas, 1993; Sitzmann, Kraiger, Steward, & Wisher, 2006, p. 627).

Procedural knowledge - information retained about how to perform a task or action (Kraiger et al., 1993). Procedural knowledge includes compilation (i.e., the proceduralizing of steps and mentally grouping the steps into a more complex production) and automaticity (i.e., accomplishing tasks without conscious

intended to *educate* the participant to apply concepts, facts, and theories to reason and to think critically? Or is the instruction meant to *train* to repeat some behavior, procedure, or process? Educating requires that participants more deeply comprehend written material, while training typically indicates they may have achieved a shallower level of comprehension (Chen, Cheng, Chang, Zheng, & Huang, 2014; Cull, 2011; Delgado, Vargas, Ackerman, & Salmerón, 2018; Durant & Horava, 2015; Hou, Nam, Peng, & Lee, 2012; Mangen, 2008; Rowe, 2013; Sage, Piazzini, Downey, & Masilela, 2020; Wolf & Barzillai, 2009).

As such, the digital medium does align better with DL, while print aligns more effectively with the traditional classroom setting. However, the alignment still depends on the instructional designer's intent. If the designer intends for the instruction is to *train* participants to perform some repetitive function or behavior, it appears that the digital medium is appropriate; yet, if the designer intends to *educate* participants to gain a deeper understanding to think differently, or to think critically using a print or a mixed format is more effective (Liu, 2006; Qayyum & Williamson, 2014; Sage, Augustine, Shand, Bakner, & Rayne, 2019; Singer & Alexander, 2016). Further, as pointed out by Bertelsen (2020, p.17) drawing from Sitzmann, et al's (2006) meta-analysis, the blended learning method appears superior to both traditional and distance learning settings.

Thus, the research points to the designer's intention for the instruction and depending on that intent, and the setting, a decision on the medium used should follow. Further, this implies that the instructional designer should avoid bouts with rational ignorance or intellectual laziness when it comes to a particular course's setting/medium combination, particularly in the information age (Somin, 2015).

To restate, the designer should *not* allow the setting to dictate the medium, as stated earlier. Instead, the instructor should engage the material and actively decide which medium is best based on the learning outcome (i.e., educational or training) desired (Sage, Augustine, Shand, Bakner, & Rayne, 2019; Sage, Piazzini, Downey, & Masilela, 2020; Singer & Alexander, 2016). Therefore, a designer could choose a

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cognitive effort, which enables simultaneous performance of additional tasks) (Sitzmann, Kraiger, Steward, & Wisher, 2006, pp. 627-628).

combination of mediums, both print and digital, or one or the other discretely – if deemed appropriate – regardless of the learning setting (Clinton, 2019; Cull, 2011; Delgado, Vargas, Ackerman, & Salmerón, 2018; Durant & Horava, 2015; Hou, Rashid, & Lee, 2017; Sage, Piazzini, Downey, & Masilela, 2020; Singer & Alexander, 2017; Sitzmann, Kraiger, Steward, & Wisher, 2006; Ziegler, 2019). What follows is a discussion of what the scholarly research says about the comprehension levels each medium attains.

C. COMPREHENSION LEVEL

First, the research needs to discretely break reading comprehension down into a typological set. Interestingly, the extant literature on reading comprehension included in this study appears binary in its descriptions on the efficacy of mediums; print mediums typically fall on the deep reading, immersion, cognitive map development side and digital mediums rest on the scanning, skimming, surveying, or discontinuous reading side. Thus, print is more conducive to declarative learning and digital aligns best with procedural learning. Nevertheless, this study explores and defines each fully to cement each medium within either the deep or the discontinuous reading typology.

1. Print Medium

The peer-reviewed scholarly literature on the preferability and the efficacy of print versus digital is nearly, albeit reluctantly, unanimous. If the learning objective is deep reading, extensive cognitive mapping, or immersion of the information read – print is the medium of choice (Chen, Cheng, Chang, Zheng, & Huang, 2014; Cull, 2011; Delgado, Vargas, Ackerman, & Salmerón, 2018; Durant & Horava, 2015; Hou, Rashid, & Lee, 2017; Mangen, 2008; Mizrachi, Salaz, Kurbanoglu, & Boustany, 2018; Sage, Piazzini, Downey, & Masilela, 2020). Deep reading of the print medium engages the mind's cognitive properties, its plasticity, and allows ingested information to map or imprint, this, in turn, assimilates declarative knowledge into the brain (Behrens, et al., 2018; Cull, 2011; Durant & Horava, 2015; Hou, Rashid, & Lee, 2017; Mangen, 2008; Mizrachi, Salaz, Kurbanoglu, & Boustany, 2018; Sage, Piazzini, Downey, & Masilela, 2020; Wolf & Barzillai, 2009; Ziegler, 2019).

Certainly, students *prefer* the print medium for academic, abstract, dense, expository, or news-related subjects, which creates a deeper level of thought and

reasoning (Cull, 2011; Hillesund, 2010; Johnston & Salaz, 2019; Liu & Huang, 2008; Mizrachi, Salaz, Kurbanoglu, & Boustany, 2018; Qayyum & Williamson, 2014; Sage, Augustine, Shand, Bakner, & Rayne, 2019; Sage, Piazzini, Downey, & Masilela, 2020; Stoop, Kreutzer, & Kircz, 2013; Wolf & Barzillai, 2009). Many neuroscientists and reading scholars connect this to print's corporeal, haptic, or tactile characteristics; they point to these as properties for entering into the deep reading experience (Behrens, et al., 2018; Hillesund, 2010; Hou, Nam, Peng, & Lee, 2012; Johnston & Salaz, 2019; Mangen, 2008; Mangen & Schilhab, 2012).[10] This does not mean that the digital medium cannot achieve a lesser or different level of participant immersion or comprehension, but scholars presently agree that participants can more effectively attain the deep reading, immersive state effectively through the use of the print medium. This is not to include immersion in the digital gaming environment, which lies outside of the scope of this research (Hou, Nam, Peng, & Lee, 2012; Witmer & Singer, 1994).

Thus, participants may not need to realize deep reading and immersion to achieve a comprehension level required to learn and use information written in either print or digital mediums. Both mediums appear to achieve different kinds of immersion; print enables the reader to achieve imaginary immersion, while digital allows for the attainment reflective immersion.[11] More precisely, each medium's inherent properties empowers readers to choose and achieve their reading purpose. Given that the print medium has linear/continuous reading properties, it frees readers to engage in the narrative's immersive imagery and creates a deeply read schemata of the absorbed storyline. This does not mean that the digital medium cannot attain the deep reading, immersive imaginary state through the digital realm – only that currently – print is more

[10] Haptic – the sense of touch and movement of hands across a medium of material, in this case, the process of reading (Hou, Rashid, & Lee, 2017, p. 86; Webster, 2017, sec. "haptic"). Synonymous with tactile.

[11] Imaginary immersion – a cognitive state in which the reader engages the linear narrative becoming engrossed in the storyline(s), both analogically and phenomenologically conceiving peoples, places, and things, living through situations, empathizing with the characters or concepts described (Hillesund, 2010, p. 6; Mangen, 2008; Rowe, 2013; Wolf & Barzillai, 2009). Closely aligned with deep reading and immersion.

Reflective immersion – a hermeneutic process or state in which the reader engages written text, non-linearly, with the goal or purpose of interpreting, learning, studying, and understanding the arguments, methods, techniques, and theories of a given set of or body of knowledge (Cull, 2011; Hillesund, 2010; Liu, 2005, p. 700; Rowe, 2013, pp. 6-7; Sage, Piazzini, Downey, & Masilela, 2020). Closely aligned with discontinuous or tabular reading.

effective at achieving that end. Nevertheless, the digital medium does prove quite useful in learning settings, contingent on the knowledge acquisition goals or purpose of the reader/researcher.

2. Digital Medium

Scholars have found that readers can attain a deep reading or imaginary immersive state while reading a novel or fiction using the digital medium, if they complete the reading on a dedicated e-reader such as a Kindle or Nook (Chen, Cheng, Chang, Zheng, & Huang, 2014; Clark, Goodwin, Samuelson, & Coker, 2008; Cull, 2011; Durant & Horava, 2015; Hillesund, 2010). Reading on these dedicated devices prevents distractions from the ubiquitous popups or the readers' temptation to multi-task when using reading applications on iPads, laptops, or desk-top computers, which tend to disrupt or interrupt a deeper reading experience (Cull, 2011; Daniel & Woody, 2013; Durant & Horava, 2015; Hillesund, 2010; Liu & Huang, 2008; Mangen A. , 2008; Wolf & Barzillai, 2009).

Thus, reading on a computer or laptop lends itself to a shallower level of cognitive engagement due to the reasons mentioned, indeed, the opportunities for distraction while using a computer or laptop are boundless. Lack of cognitive engagement may be a byproduct of overconfidence in the digital medium' predicted performance. In fact, the subjects of these reading experiments covered in this report displayed a significant level of *overconfidence* of reading comprehension while engaged in the digital medium, which can cause other issues to arise in the digital versus print debate (Ackerman & Goldsmith, 2011, p. 29; Ackerman & Lauterman, 2012; Clinton, 2019; Delgado, Vargas, Ackerman, & Salmerón, 2018; Mangen, Walgermo, & Brønnick, 2013; Singer-Trakhman, Alexander, & Silverman, 2018). This metacognitive measure, known as calibration, reveals a distinct difference between a digital reader's level of confidence or prediction of their reading performance versus their actual performance; the latter is demonstrably less than the former (Clinton, 2019; Singer & Alexander, 2016). Additionally, the digital medium levies a higher cognitive load on the readers brought on by hypertexts, flickering liquid crystal displays, pop-ups, opportunities to multi-task, and other distractions that indwell the medium (Chen, Cheng, Chang, Zheng,

& Huang, 2014; Daniel & Woody, 2013; Durant & Horava, 2015; Eshet-Alkalai & Geri, 2007; Liu, 2005; Stoop, Kreutzer, & Kircz, 2013; Wästlund, 2007).

Nevertheless, immediate gratification seems to closely align with digital materials. Overuse or over–exposure to the digital medium, however, can stunt readers' cognitive engagement; this can lead readers to a retreat to less demanding thinking patterns and materials (Clinton, 2019; Delgado, Vargas, Ackerman, & Salmerón, 2018; Chen, Cheng, Chang, Zheng, & Huang, 2014; Garland & Noyes, 2004; Hou, Rashid, & Lee, 2017; Kaufman & Flanagan, 2016; Mangen, Walgermo, & Brønnick, 2013; Sage, Augustine, Shand, Bakner, & Rayne, 2019; Singer & Alexander, 2016). Further, Duggan and Payne (2011) suggest that readers use the digital medium to indulge in *satisficing* reading behavior, using scanning or skimming techniques to find specific information.[12] And if the reader does not quickly obtain that information, they will move on quickly to other texts seeking to achieve the same goal. This behavior is also similar to information–seeking behavior, where the reader scours the text in pursuit of a discrete piece of information (Case & Given, 2016; Dervin & Naumer, 2009).[13]

Hillesund (2010) suggests that digital mediums are more conducive to this reflective immersive, goal-oriented reading. Essentially, readers use the texts to study specific information, then subsequently reflect or ruminate on that information to gain a deeper understanding of the subject. Certainly, this type of reading behavior manifests itself more in the behaviors of students or academics, as they ingest information in preparation for an exam or in the formulation of an academic paper, like this report (Cull, 2011; Hillesund, 2010; Liu, 2005; Ross, Pechenkina, Aeschliman, & Chase, 2017; Singer-Trakhman, Alexander, & Silverman, 2018; Stoop, Kreutzer, & Kircz, 2013). Thus, these academicians or learners *discontinuously* jump around in the material procedurally, taking notes, learning, making connections, as they sift through the material. As such, this may be the position of digital to be in support of print within the

[12] Satisficing in this context would mean reading to gain a "good enough" understanding of the information sought, so as to allow the reader to move onto the next objective (Duggan & Payne, 2011; Simon, 2019).

[13] Interestingly, an individual's *wants* manifest themselves in observable behaviors; whereas *desires* or *needs* do not and most individuals find it difficult, if not impossible, to articulate them (Case & Given, 2016).

given learning settings, particularly, if the instructional designer seeks an educational outcome through the mixed or combined use of print and digital, which may be the correct vector.

D. CONCLUSION

Thus, it appears that print allows the reader to gain a deeper level of comprehension than the digital medium. Yet, even if that is the case, the ubiquitous use of the digital medium in a person's lifeworld demands the placement and use of it in the learning settings.[14] Finally, is the dedicated tablet reader, with its lack of distraction and prevention of multi-tasking, a suitable solution to the print versus digital debate. As such, the below hypotheses are proffered for consideration and empirical testing in the discussion and analysis to follow.

Hypothesis #1 (H1): The *print* medium empowers the reader to achieve a level of comprehension *higher* than that of the digital medium.

Hypothesis #2 (H2): The *digital* medium places a higher cognitive load on the reader *greater* than that of the print medium.

Hypothesis #3 (H3): The dedicated *digital tablet* empowers the reader to achieve a level of reading comprehension higher than that of the *print* medium.

Figure 2. Technical Report Hypotheses

[14] Lifeworld – best describes a human's socially constructed reality, where the individual hears from, speaks to, and interacts with the world around them, interacting with their day-to-day world system. Habermas (1987) clarifies that a person's communications (i.e., hearing, reading, and speaking) in the modern world system is semantically laced with propositional, illocutionary, and expressive components that in effect can do harm or "violence" to a person's lifeworld; thereby, constraining clear communication and hampering the ability to achieve societal consensus on given issues. This harm or violence to the lifeworld of individuals causes pathologies and crises that lead to serious social problems (Habermas, 1987; Ryan, 2005).

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III. ANALYSIS AND CONCLUSION

A. INTRODUCTION

As discussed in the literature review, each medium enjoys a specialized niche in comprehension and immersion. This chapter has several goals. First, this chapter aims to present the result of the analysis conducted, which is mainly focused on each medium's achieved level of reader comprehension, testing the hypotheses offered earlier. Subsequently, a discussion follows intent upon placing the mediums in their perspective learning settings, which is meant to address the report's research question.

B. ANALYSIS

The analysis used to test the hypotheses consists of a meta-analysis of 21 scholarly articles, which employed qualitative, quantitative, and mixed methods experiments of over 3,000 participants. The author combined these experimental research articles with five meta–analysis publications, encompassing 184 articles using various types of experiments (i.e., qualitative, quantitative, etc.) covering 211,510 participants. Finally, ten scholarly qualitative articles surveying the print and digital medium space. Thus, equating to the 36 articles covered in this study tabulated in Appendix A.

1. Hypothesis 1[15]

The aim here is to test, which medium achieves the superior level of comprehension. Figure 3 drawn from the data accumulated in Appendix A quantifies that 90 percent or 19 out of the 21 articles covering experiments conducted accede that print is superior to digital. Two articles did not agree with this conclusion. They include the Sage, et al (2020), which concluded that the digital tablet format was equal to print. The other, Eshet-Alkalai and Geri (2007), found that half, the high school newspaper readers, comprehended the digital medium better and the other half of the college student newspaper readers comprehended better through the paper medium, which the researcher found inconclusive.

[15] **Hypothesis #1 (H1):** The *print* medium empowers the reader to achieve a level of comprehension *higher* than that of the digital medium.

Further as per Figure 3, 80 percent of the meta-analysis and 89 percent of the qualitative articles reviewed agreed that print achieved superior comprehension levels over the digital medium. Noyes and Garland (2008) contained in the meta-analysis and Rowe (2013) in the qualitative review judge that it depends on the reader's purpose. In the latter analysis Clark, et al. (2008), in the qualitative review, mainly focused on the efficacy of the Kindle digital tablet but did not make a comparison and was therefore not considered in the percentage counts. As such, substantial evidence exists across the thirty-six articles reviewed that supports acceptance of H1 and rejection of the null. Indeed, at the present time, print allows the reader to achieve a higher level of comprehension over digital.

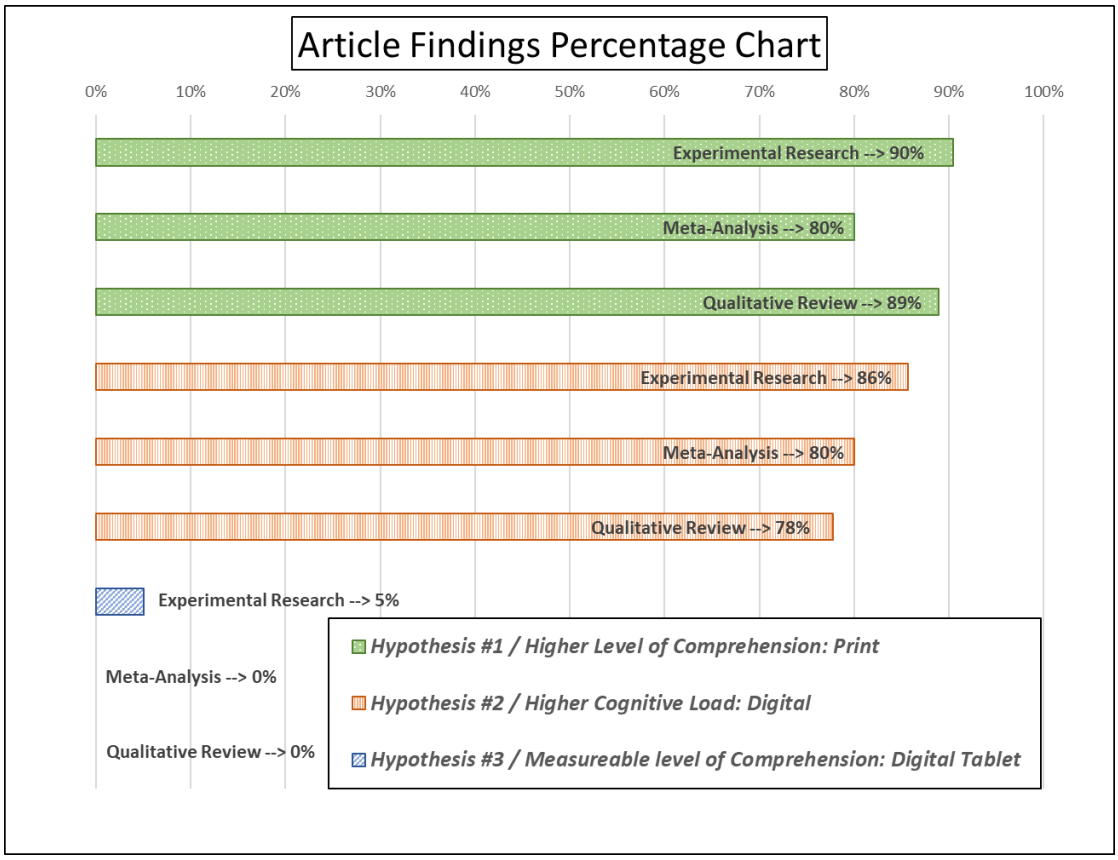

Figure 3. Scholarly article results comparison

2. Hypothesis 2[16]

The goal here is to assess the cognitive load placed on the reader when using the digital medium, because of its non-corporeal properties replete with manifold distractions. The aggregated percentages presented in Figure 3, and tabularly in Appendix A, reveals that 18 out of the 21 articles or 86 percent score the digital medium as demanding a greater cognitive load over print, with two papers not gathering this type of information. While the meta-analysis and qualitative articles reviewed scored digital's cognitive load as higher than print at 80 percent and 78 percent, respectively. As such, the majority of the evidence presented in this report supports the acceptance of H2 and rejection of the null. The digital medium appears to be more cognitively taxing than print.

3. Hypothesis 3[17]

The intent here is to examine whether the digital medium provided in a dedicated tablet device, such as a Kindle or Nook, vice in print or straight digital is superior in comprehension to both mediums alone. This report proffers this hypothesis because some scholars believe that a dedicated digital tablet might perform better than print and other digital presentations means (Chen, Cheng, Chang, Zheng, & Huang, 2014; Cull, 2011; Johnston & Salaz, 2019; Mangen A. , 2008; Mizrachi, Salaz, Kurbanoglu, & Boustany, 2018; Rowe, 2013; Sage, Augustine, Shand, Bakner, & Rayne, 2019; Sage, Piazzini, Downey, & Masilela, 2020; Stoop, Kreutzer, & Kircz, 2013). Further, many scholars have stated that comprehension level depends on the reader's purpose for reading, meaning deep reading, immersive imaginary or immersive reflective, or discontinuous reading (Cull, 2011; Hillesund, 2010; Hou, Rashid, & Lee, 2017; Liu, 2006; Noyes & Garland, 2008; Qayyum & Williamson, 2014; Rowe, 2013; Sage, Augustine, Shand, Bakner, & Rayne, 2019). Nevertheless, when reviewing the tally from the three different analysis groups in Appendix A, *only* the Sage, et al (2019) article provided evidence indicating a dedicated digital tablet rose to a level *equivalent* to that of

[16] **Hypothesis #2 (H2):** The *digital* medium places a higher cognitive load on the reader *greater* than that of the print medium.

[17] **Hypothesis #3 (H3):** The *digital tablet* empowers the reader to achieve a level of reading comprehension *higher* than that of the *print* medium.

print when testing for level of comprehension. Thus, only one out of the 21 articles reviewed or 5 percent in that analysis group indicate equivalence to print only. Additionally, while many articles across the three analysis groupings imply that the reader's *purpose matters*, none provide strong evidence that a dedicated tablet would make a difference in level of comprehension. Thus, based on the evidence provided in surveying the 36 articles little evidence suggests that the digital tablet medium enables reading comprehension to rise above print. As such, this evidence supports rejection of H3 in favor of the null.

C. CONCLUSION

This analysis firmly establishes the supremacy of print when the instructional designer requires a deep level of comprehension from the reading material used in the course of instruction. Yet sometimes, the designer goals may not base their goals on comprehension levels, and instead may have a goal centered on different types of immersive effects. At times, they may focus the instruction on reflective immersive rather than imaginary immersive.

1. Discussion

Again, many authors, although not overwhelmingly so, have posited that in-depth study and a deeper learning experience across the breadth of a theoretical or a topical area may require the reflective immersive or procedural modality (Cull, 2011; Hillesund, 2010, p. 5; Liu, 2005, p. 700; Kraiger, Ford, & Salas, 1993; Sitzmann, Kraiger, Steward, & Wisher, 2006). While many have stated it is the reader's purpose that determines the style of reading they choose (Ackerman & Goldsmith, 2011; Cull, 2011; Hou, Rashid, & Lee, 2017; Hillesund, 2010; Mangen & Schilhab, 2012; Noyes & Garland, 2008; Qayyum & Williamson, 2014, Rowe, 2013; Sage, Augustine, Shand, Bakner, & Rayne, 2019; Sage, Piazzini, Downey, & Masilela, 2020; Singer & Alexander, 2016). Further, Eshet-Alkalai and Geri (2007) found some evidence that the digital medium may be better suited for use by younger people, digital natives who grew up with technology and are consequently better trained in or accustomed to its use. Nevertheless, this finding remains *inconclusive* at the moment (Eshet-Alkalai & Geri, 2007; Singer & Alexander, 2017). As such, looking to the material taught and the instructional designer's intent may

be a better measure than simply print versus digital, for determining the medium to use in a program of instruction.

If the material taught requires a deep theoretical or declarative modality tied together in a linear story-like fashion, where discrete pieces build upon each other to form a comprehensive schema of understanding, then print may be the most appropriate medium. Yet, if one wants to research or study a given topic area extensively – the digital medium may be a better fit. Thus, it comes down to the instructional designer's purpose and the skill level of the student as they traverse across the given mediums and platforms.

This study has provided scholarly evidence that print holds the superior position when the instructional aim is deep reading, achieving high levels of comprehension, or declarative learning. Further, the digital medium does tax the reader with a heavier cognitive load over that of the paper medium. Finally, as for the dedicated e-reading tablet, while superior to the generic digital medium replete with manifold distractions, the evidence provided does not conclude that it is superior to print.

When taking all of these findings into account, regrettably, one arrives at the classical cliché of *it depends*. It depends on the instructional designer's goals in creating their instruction. It depends on the type of learning setting (blended, DL, or traditional) presented to and intended to engage the reader. It depends on the amount of time available for readers to decompress from the cognitive load placed on them when engaged in the digital medium. It depends on the reader's level of comfort with and training in the digital medium, which assumes a level of both in use of the print medium. As such, the recommendations follow.

2. Recommendations

First, if the instructional designer's goal is to educate participants to apply concepts, facts, and theories while thinking critically, then the designer should devote some time to thinking through how, beyond the superficial, to match the learning setting with the medium or mediums of choice. Secondly, if the reader discretely chooses the digital medium, the designer must consider the drawbacks of its use, not the least of which is the increased cognitive load placed on the participant. As such, the designer should consider an appropriate number of breaks or time away from the medium.

Thirdly, designers and academicians should think through how to train readers to successfully use the digital medium to ensure the participants are well prepared to make effective use of the course material.

Finally, if the reader is engaging the material for their own edification or study, then they should choose the medium most efficacious to their activity. If they are engrossed in study pursuing specific information, reflectively immersing in the text and seeking a procedural level of learning using both mediums, optimizing the advantages of each while minimizing the disadvantages, may be their best option. If the reader is engaged in linear reading, which builds distinct pieces of information atop each other to form an overall concept, storyline, or understanding, imaginatively immersing in the material to create a declarative level of knowledge with its incumbent schema structure, then print may be the medium of choice.

There is little doubt that this debate will continue unabated for some time as scholars wrestle with the efficacy of each medium in the fields of education and learning. Regardless, for now, print remains superior in its ability to engage humankind in deep comprehension. But, as has been drawn out in this research, digital has its place and should not be disregarded either now or in the future.

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APPENDIX A: ANALYSIS TABLES

Experimental Research Articles											
#	Scholar	Sample size from Population	Type of Experiment	Higher level of Comprehension: Print	Higher level of Comprehension: Digital	Higher Cognitive Load: Digital	Measureable level of Comprehension: Digital Tablet	Depends on Reading Purpose	Digital Overconfidence Indicated	Digital Training Recommended	Other (Notes)
1	Ackerman & Goldsmith, 2011	126	Quantitative	X		X		X	X	X	Requirement of ***training*** in use of the digital medium - **implied**.
2	Ackerman & Lauterman, 2012	42	Quantitative	X		X			X		
3	Ben-Yehudah & Eshet-Alkalai, 2018	140	Quantitative	X		X					Used accepted qualtitative measure in reading paragraph structure during the experiment.
4	Chen, Cheng, Chang, Zheng, & Huang, 2014	90	Quantitative	X		X				X	
5	Eshet-Alkalai & Geri, 2007	80	Quantitative			X					Introduced the concept of information economics. Used newspapers - results mixed
6	Garland & Noyes, 2004	50	Quantitative	X							
7	Hou, Rashid, & Lee, 2017	45	Quantitative	X		X		X			
8	Johnston & Salaz, 2019	471	Qualitative	X		X					Questionaire - (17) Likert-scale
9	Kaufman & Flanagan, 2016	337	Qualitative	X		X					Questionaire - (25) Likert-scale / Self-assessment
10	Liu, 2005	113	Qualitative	X		X					Questionaire - (17) Reading experience
11	Liu, 2006	133	Qualitative	X		X		X			Questionaire - (13) Reading experience
12	Liu & Huang, 2008	203	Qualitative	X		X					Questionaire - (18) Reading experience (Chinese participants)
13	Mangen, Walgermo, & & Brønnick, 2013	72	Quantitative	X		X			X		
14	Qayyum & Williamson, 2014	14	Qualitative	X				X			Questionaire - (5 Tasks) Reading experience / interpretive-ethnographic. Used newspaper, paper for indepth / digital quick cursory access to information.
15	Sage, Augustine, Shand, Bakner, & Rayne, 2019	120	Mixed-Methods				X	X			Print and digital comparable for study, mixed use recommended. **Tablet equivalent to print.**
16	Sage, Piazzini, Downey, & Masilela, 2020	144	Quantitative	X		X		X			Mixed use of both mediums recommended.
17	Singer & Alexander, 2016	90	Quantitative	X		X		X	X		Yet, the meta-cognitive impact remains unsettled. Mixed use of both mediums recommended. Reluctantly found print to be superior.
18	Singer-Trakhman, Alexander, & Silverman, 2018	57	Quantitative	X		X					Created a typology of regulators, plodders, samplers, and gliders
19	Stoop, Kreutzer, & Kircz, 2013	572	Mixed-Methods	X		X					
20	Wästlund, 2007	374	Quantitative	X		X					Screens caused greater stress and increased cognitive workload leading to higher fatigue over shorter periods of time. Two experiments used Likert scale questionaires for individual assessments.
21	Ziegler, 2019	275	Quantitative	X		X		X			
	SubTotals: Sample Count	3548									
	Quantitative		13								
	Qualitative		6								
	Mixed-Methods		2								
	Totals			19	0	18	1	8	4	2	
	Percentage Totals			90%	0%	86%	5%	40%	20%	10%	

Meta-Analysis of Scholarly Experiments Conducted

#	Scholar	# of Articles	# of Participants in Experiment	Higher level of Comprehension: Print	Higher level of Comprehension: Digital	Higher Cognitive Load: Digital	level of Comprehension: Digital Tablet	Depends on Reading Purpose	Other (Notes)
1	Clinton, 2019	33	1,931	X		X			
2	Delgado, Vargas, Ackerman, & Salmerón, 2018	54	171,055	X					Digital natives display overconfidence in digital medium
3	Mizrachi, Salaz, Kurbanoglu, & Boustany, 2018	*Multi-datasets	10,293	X		X			Cross-National and Gender
4	Noyes & Garland, 2008	61	28,231			X		X	Tested Digital Print Equivalency. **Findings refuted by Ackerman & Goldsmith, 2011.**
5	Singer & Alexander, 2017b	36	-	X		X			
	Totals	184	211,510	4	0	4		1	
	Percentage Totals			80%	0%	80%	0%	20%	

Qualitative Scholarly Review of Literature

#	Scholar	Type of Review	Higher level of Comprehension: Print	Higher level of Comprehension: Digital	Higher Cognitive Load: Digital	level of Comprehension: Digital Tablet	Depends on Reading Purpose	Other (Notes)
1	*Clark, Goodwin, Samuelson, & Coker, 2008							Kindle(Inconclusive)
2	Cull, 2011	R	X		X		X	
3	Durant & Horava, 2015	R	X		X			
4	Hillesund, 2010	SI	X		X		X	
5	Mangen, 2008	R	X		X			
6	Mangen & Schilhab, 2012	R	X		X			
7	Ross, 2017	R	X		X			
8	Rowe, 2013	R					X	
9	Walsh, 2016	R	X					Literature Review
10	Wolf & Barzillai, 2009	R	X		X			
	Totals		8	0	7	0	3	
	Percentage Totals		89%	0%	78%	0%	33%	

Legend:

R - Qualitatve review of scholarly

SI - Structured Interview

* Not an equivalent comparison to the other studies.

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APPENDIX B: GLOSSARY

B.

Blended learning – education or training that occurs via a mixed-methods (i.e., DL and traditional learning) presentations, whereby participants engage in the activity through varying combinations of distance and traditional learning (Bertelsen, 2020, p. 7).

C.

Cognitive Load – focuses on the interplay between working memory (i.e., short-term), with its limited capacity and duration versus long-term memory (Sweller, 2015). In the context of this paper, a reader must manage their cognitive resources to gain the knowledge they seek. Excessive cognitive load can lead to fatigue, increased likelihood of distraction, reduced satisfaction, and lowered confidence in reading performance (Ben-Yehudah & Eshet-Alkalai, 2018; Chen, Cheng, Chang, Zheng, & Huang, 2014; Hou, Rashid, & Lee, 2017; Johnston & Salaz, 2019; Kaufman & Flanagan, 2016; Liu & Huang, 2008; Mangen, Walgermo, & Brønnick, 2013; Sage, Piazzini, Downey, & Masilela, 2020)

Cognitive map – refers to the internal model of the world, created by the reader, that accounts for the relationships between events and predicts the consequences of actions (Behrens, et al., 2018, p. 490; Bielenia-Grajewska, 2013; Hou, Rashid, & Lee, 2017).

Comprehension – Retrieving previously acquired schema to assist in processing and understanding new and unfamiliar information while reading or listening to text (Ortlieb, Sargent, & Moreland, 2014; Ziegler, 2019, p. 10). See schema theory.

D.

Declarative knowledge – a set of facts, concepts, principles, and theories taught and their relationship among knowledge elements retained for their use in differing future situations (Bertelsen, 2020, p. 11; Kraiger, Ford, & Salas, 1993; Sitzmann, Kraiger, Steward, & Wisher, 2006, p. 627).

Deep reading - the array of sophisticated processes that propel comprehension and that include inferential and deductive reasoning, analogical skills and imagery of the narrative, largely linear in execution – reading from start to finish, gaining knowledge through the use of an immersive imaginary heuristic (Cull, 2011; Durant & Horava, 2015, p. 9; Hillesund, 2010; Liu, 2005; Rowe, 2013; Wolf & Barzillai, 2009, pp. 32-33). *Synonymous* in this report with *continuous*, *immersive imaginary*, or *linear reading*, defined by its fundamental integrity of form and content and its innate ability to support sustained engagement between the reader and the text (Durant & Horava, 2015; Hillesund, 2010; Rowe, 2013; Wolf & Barzillai, 2009).

Discontinuous reading – a. reading non-linearly, back and forth, jumping around in the text, reading out of order, or reading snippets to gain specific knowledge (i.e., question and answer schema), context, or to decide whether to read further; employing an immersive reflective heuristic to understand connections, to interpret and learn the specifically sought elements of the material read, largely done in research or study settings (Cull, 2011; Hillesund, 2010, p. 5; Liu, 2005, p. 700). b. reading as an information seeking or interrogatory endeavor about a specific subject, using organizational constructs within the given text such as annotations, bibliographies, glossaries, hyperlinks, indices, or tables of content to obtain the information sought, indicative of a shallower level of cognitive processing (Cull, 2011; Hillesund, 2010; Liu, 2005, p. 700; Rowe, 2013, pp. 6-7; Sage, Piazzini, Downey, & Masilela, 2020). *Synonymous* in this report with *reviewing*, *scanning*, *skimming*, or *tabular* reading, where the reader rapidly scans the given text for keywords, phrases, images to assuage their information-seeking need or to swiftly learn the knowledge required.

Distance learning (DL) – education or training delivered at a distance from the hub of instruction, through the use of information technology enabled instructor and learner tools or interfaces (Bertelsen, 2020, p. 7). DL can be asynchronous or synchronous.

H.

Haptic – the sense of touch and movement of hands across a medium of material, in this case, the process of reading (Hou, Rashid, & Lee, 2017, p. 86; Webster, 2017, sec. "haptic"). Synonymous with tactile.

I.

Information Technology (IT) Systems – Includes all categories of ubiquitous technology used for the gathering, storing, transmitting, retrieving, or processing of information (e.g., microelectronics, printed circuit boards, computing systems, software, signal processors, mobile telephony, satellite communications, and networks). Synonymous with Information and Communications Technology (Committee on National Security Systems, 2015, p. 62).

Internet – the single, interconnected, worldwide system of commercial, governmental, educational, and other computer or digital information systems or networks that share (a) the protocol suite specified by the Internet Architecture Board (IAB) and (b) the name and address spaces managed by the Internet Corporation for Assigned Names and Numbers (ICANN) (Committee on National Security Systems, 2015, p. 70; Valeriano & Maness, 2015, pp. 9-17). Used throughout this paper as synonymous with the World Wide Web (WWW), cyberspace, or cyber domain.

Imaginary immersion – a cognitive state in which the reader engages the linear narrative becoming engrossed in the storyline(s), both analogically and phenomenologically conceiving peoples, places, and things, living through situations, empathizing with the characters or concepts described (Hillesund, 2010, p. 6; Mangen, 2008; Rowe, 2013; Wolf & Barzillai, 2009). Closely aligned with deep reading and immersion.

Immersion – refers to the sense of engagement or an experience of losing oneself in an environment; a complete focus on the environment and an appealing engrossment free of distraction or interruption (Hou, Nam, Peng, & Lee, 2012; Hou, Rashid, & Lee, 2017, p. 88; Mangen, 2008, pp. 406-407; Witmer & Singer, 1994).

L.

Lifeworld – best describes a human's socially constructed reality, where the individual hears from, speaks to, and interacts with the world around them, interacting with their day-to-day world system. Habermas (1987) clarifies that a person's communications (i.e., hearing, reading, and speaking) in the modern world system is semantically laced with propositional, illocutionary, and expressive components that in effect can do harm or "violence" to a person's lifeworld; thereby, constraining clear communication and

hampering the ability to achieve societal consensus on given issues. This harm or violence to the lifeworld of individuals causes pathologies and crises that lead to serious social problems (Habermas, 1987; Ryan, 2005).

M.

Metacognitive [learning] regulation (MLR) - refers to higher-order thinking which involves active control over the cognitive processes engaged in learning toward achieving one's goals (Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012, p. 2).

N.

Narrative Theory – a. the institutionalized use of semiotic structures or codes to allow narrators (i.e., authors), and readers to communicate through texts; thereby, allowing the reader to understand and make sense of a given situation described in the story (Barbatsis, 2004; Kearns, 2005). b. information that actively engages the senses using language to create structure that draws in the reader or listener, intentionally, leaving out pieces of information, or the other side of the story, in an effort to engage the reader or listener by inviting them to us their imagination to fill in the missing information and discern what really happened (Wake, 2009, p. 674).

P.

Procedural knowledge - information retained about how to perform a task or action (Kraiger et al., 1993). Procedural knowledge includes compilation (i.e., the proceduralizing of steps and mentally grouping the steps into a more complex production) and automaticity (i.e., accomplishing tasks without conscious cognitive effort, which enables simultaneous performance of additional tasks) (Sitzmann, Kraiger, Steward, & Wisher, 2006, pp. 627-628).

R.

Reflective immersion – a hermeneutic process or state in which the reader engages written text, non-linearly, with the goal or purpose of interpreting, learning, studying, and understanding the arguments, methods, techniques, and theories of a given set of or body

of knowledge (Cull, 2011; Hillesund, 2010; Liu, 2005, p. 700; Rowe, 2013, pp. 6-7; Sage, Piazzini, Downey, & Masilela, 2020). Closely aligned with discontinuous or tabular reading.

S.

Schema Theory - a set of ideas related to the cognitive structures that help individuals order, present, evaluate, and apply human knowledge and skills by dividing available information into meaningful units (Bielenia-Grajewska, 2013, p. 675). Also, can be referred to as schemata or schema theory.

T.

Traditional learning – education or training furnished in an in-person, face-to-face, format, is instructor and learner centric, and commonly includes a combination of lectures, case studies, problems, readings, and facilitated peer discussions in a traditional classroom setting (Bertelsen, 2020, p. 7).

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